MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EMG4076 – ELECTROMAGNETIC INTERFERENCE

(TE/RE)

22 OCTOBER 2018
9.00 A.M. – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages with 4 Questions only.

2. Attempt all **FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Consider three parallel wires, two are signal leads (lead-1 and lead-2) and the third is a common signal-return lead (lead-G). Lead-1 is shielded with a copper sleeve as shown in **Figure Q1a**.

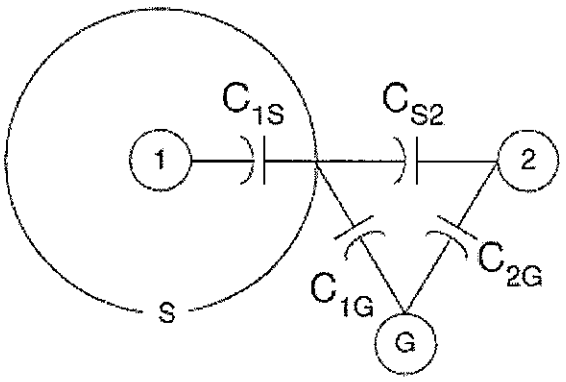

Figure Q1a

(i) State the effect on the capacitive coupling between lead-1 and lead-2 if the shield is not grounded.

[2 marks]

(ii) If the shield is grounded with a pigtail-lead, draw the equivalent circuit for the capacitive coupling.

[4 marks]

(iii) By analyzing the equivalent circuit in (a)(ii), assuming the source resistance of the signal source of lead-1 is negligible, find the expression for the noise voltage V_N, on lead-2. Include the effect of pigtail-lead inductance.

[13 marks]

(b) With the aid of diagram, explain the implementation of balance circuit in reducing the noise voltage due to inductive coupling.

[6 marks]

Continued...

Question 2

(a) With the aid of diagrams, explain about the 'hybrid ground' system.

[6 marks]

(b) **Figure Q2b** shows a poorly designed ground layout for a motor subsystem.

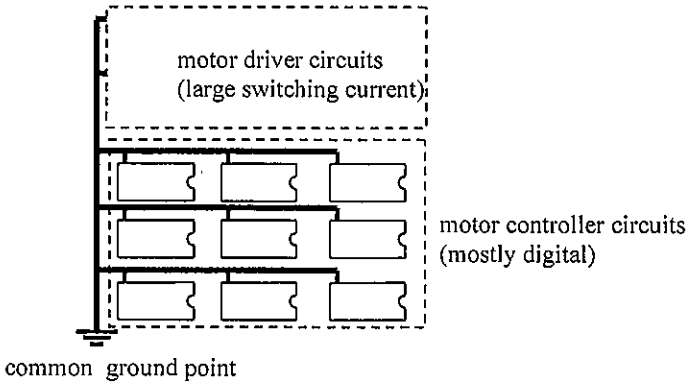

Figure Q2b

(i) Discuss two potential problems with such a ground layout.

[4 marks]

(ii) Suggest a better ground layout for the subsystem.

[4 marks]

(c) For the circuit in **Figure Q2c,** find the expression for the ground noise coupled into the differential amplifier, V_N. Calculate the relative magnitude (in dB) of the V_N with respect to the signal voltage V_S when R_{in} is

(i) 100 kΩ,

(ii) 1 MΩ,

(iii) 10 MΩ.

[11 marks]

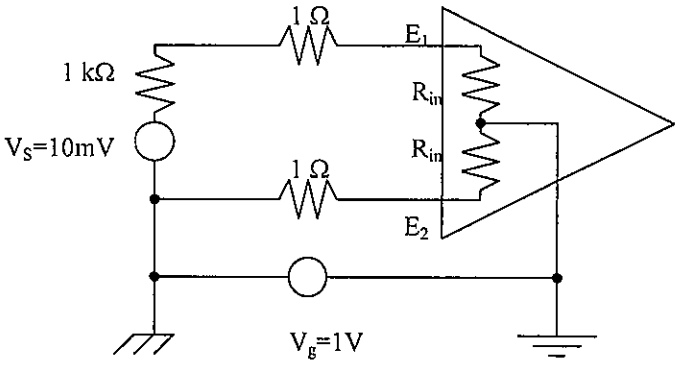

Figure Q2c

Continued...

Question 3

(a) Wire passing through into a shielded enclosure can conduct noise current through the hole and then re-radiates the wave into the air space. Propose five (5) treatments to reduce the electromagnetic interference (EMI) for LOW frequency lead that is passing through a hole into a shielded enclosure.

[10 marks]

(b) A panel, 12 cm wide and 36 cm high, is attached to a cabinet by 24 equally spaced screws around its perimeter, including one screw at each corner. The equipment in the cabinet generates a 150 MHz signal. Assume all the phases of the signals from all slots are equal and neglect any interference to aperture currents from adjacent slots,

(i) Calculate the attenuation of this signal when it passes through the resulting slots and reach the receiving antenna 30 m away from the shield.

[6 marks]

[Hint: Attenuation A due to a slot of length l at a distance r from the slot is approximately $A = 73 - 132.45\frac{l}{\lambda} + 20\log\frac{r}{\lambda}$ dB where λ is the wavelength of the signal.

(ii) If 8 equally spaced screws are used, including one at each corner, how much is the attenuation when the signal pass through the resulting slots to reach the receiving antenna in (b)(i)?

[5 marks]

(iii) From your answer in (b)(i) and (b)(ii), which case is more effective in reducing the electromagnetic interference (EMI). Justify your answer.

[4 marks]

Continued...

Question 4

(a) Briefly describe the roles played by the Federal Communication Commission (FCC), the European Committee for Electrotechnical Standardization (CENELEC) and the International Electrotechnical Commission (IEC) in defining EMC standards. [9 marks]

(b) The FCC radiated emission limits for Class B digital devices are shown in **Table Q4b**. Determine those levels at 10 meters for Class B digital devices in dBμV/m. [6 marks]

Table Q4b

Frequency	Class-B limits at 3m
30 - 88 MHz	100 μV/m
88 - 216 MHz	150 μV/m
216-960 MHz	200 μV/m
Above 960 MHz	500 μV/m

(c) Sketch the setup of test facility for conducted emission measurements. Explain two (2) main functions of Line Impedance Stabilization Network (LISN) during the test. [6+4 marks]

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